1. Lab One-Half

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LAB 1/2 The Silicon Photodiode

In this lab, we will continue what we started in the first lab and look at the silicon photodiode detector. There are actually three of them available in the lab. A large one (3.6 mm2 in area) and two smaller ones (0.8 mm2) The holders have a battery inside them, so we will be using the diodes in the photoconductive mode. There is a convenient switchable load resistor box, so you can chose among several different values for the diode load resistor.

It is normal to use photodiodes to measure power density (watts/unit area) rather than in watts, because it is usually hard (and not very reliable) to focus the entire beam onto the diode surface.

Find a fairly long focal length lens, and go beyond its focal point so that the laser beam is expanding. Find a location where the beam is about 1 cm in diameter. Then, use one of the apertures to pick out about the center half of the beam (~0.5 cm diameter). As we shall see later in the semester, the beam is not entirely uniform in intensity over this area. It actually has a Gaussian profile. However, for our needs here we can assume that it is uniform. Using the power meter, measure the energy in the beam coming through the iris, and compute the energy density.

Put the chopper in the beam, and using the 'scope make measurements of the response of each of the photodiodes for various load resistor values. Use some of the attenuators so that you can plot diode response as a function of intensity. What kind of plot (linear, semi-log or log would be most appropriate here?) Do you observe any saturation of the diode response with the amount of power we have available from our laser ? For each of the load resistors, also make a note of the noise "floor", the magnitude of the noise signal you see with no laser light on the diode. (You can also see if it changes when you change the bandwidth setting of the scope.) From this, and your response curves, make an estimate of the NEP (noise equivalent power) for the diode detectors. Does this value depend on room ambient lighting conditions? What seems to be limiting amount of noise you detect?